Financing Opportunities for Renewable Energy Development in Alaska

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About the DOE Office of Indian Energy

The DOE Office of Indian Energy was established by Congress to provide federally recognized Tribes and Alaska Native entities with technical and financial assistance to encourage, facilitate, and accelerate energy and energy infrastructure development in Indian Country.

In direct response to the requests of Tribes and Alaska Native villages, the DOE Office of Indian Energy has designed key programs to supply tribal leaders and their staffs with the knowledge needed to make informed energy decisions—decisions with the power to help:

- Stabilize energy costs
- Enhance energy security
- Strengthen tribal energy infrastructure
- Promote tribal self-determination.

By providing reliable, accurate information, quality training, and expert technical assistance, the DOE Office of Indian Energy seeks to empower Tribes with resources, skills, and analytical tools that bolster decision making and increase capacity to advance the next generation of energy development in Indian Country.

List of Abbreviations and Acronyms

AEA	Alaska Energy Authority
AIDEA	Alaska Industrial Development Export Authority
ANC	Alaska Native corporation
AREF	Alaska Renewable Energy Grant Fund
ARRA	American Recovery and Reinvestment Act
ASSETS	Alaska Sustainable Strategy for Energy Transmission and Supply
CCAP	Coastal Community Action Program
CDE	community development entity
CDFI	Community Development Financial Institutions (Fund)
CHP	combined heat and power
CIRI	Cook Inlet Region Incorporated
CSP	concentrating solar power
DNI	direct normal irradiance
DOE	U.S. Department of Energy
DSIRE	Database of State Incentives for Renewables and Efficiency
EERE	U.S. Department of Energy Office of Energy Efficiency and Renewable Energy
IRR	internal rate of return
ITC	Investment Tax Credit
MACRS	Modified Accelerated Cost Recovery System
MSW	municipal solid waste
NEG	net excess generation
NMTC	New Market Tax Credit
NREL	National Renewable Energy Laboratory
PPA	power purchase agreement

PTC	Production Tax Credit
PV	photovoltaics
QECB	Qualified Energy Conservation Bonds
REAP	Rural Energy for America Program
REC	renewable energy credit
RPS	renewable portfolio standard
SBA	Small Business Administration
SPE	special purpose entity
USDA	U.S. Department of Agriculture
USDA-RD	U.S. Department of Agriculture Rural Development

Glossary of Commonly Used Financing Terms

Bridge Loan
A short-term loan used until permanent financing is secured; enables borrower to meet current obligations by providing immediate cash flow.

Commercial-Scale Project
A stand-alone project with a primary purpose of generating revenue resulting in financial self-sufficiency.

Community-Scale Project
Multiple buildings; campuses with a primary purpose of offsetting community energy costs to promote energy self-sufficiency.

Developer
Organizes the various parties involved in the project and typically controls and makes an equity investment in the company or other entity that owns the project.

Flip
Renewable energy development partnership structure in which a nontaxable entity partners with a taxable entity to capture tax credit benefits of renewable energy development.

Investment Tax Credit
Reduces federal income taxes for qualified tax-paying owners based on capital investment in renewable energy projects and is earned when equipment is placed in service.

Landowner/Site Owner
Legal and/or beneficial owner of land and natural resources.

Lease Pass-Through
Renewable energy financing strategy in which multiple parties participate. The project is majority owned by a tax-equity partner to capture benefits and pass through to nontaxable entity owner.

Lender
A single or group of financial institutions that provide a loan to the project company to develop and construct the project and that take a security interest in all of the project assets.

Modified Accelerated Cost Recovery System
Enables certain investments in wind, geothermal, and solar technologies to be recovered over a 5-year schedule in lieu of the standard life of the asset; improves the economic viability of a project by reducing tax liability in the initial years of production.

Net Metering
Billing system that provides customers with credit for electricity generated from distributed resources (such as photovoltaic energy); host often receives the full retail value for the excess electricity generated by the system that is fed back to the utility grid.

New Market Tax Credit
Allows individual and corporate taxpayers to receive a federal income tax credit for making qualified equity investments in qualified community development entities (CDEs). CDEs must be designated by the Community Development Financial Institutions (CDFI) Fund, which is a division of the U.S. Department of the Treasury. The NMTC equals 39% of the investment and is claimed over a 7-year period.

Off-taker
Purchaser of the electricity from a renewable energy system. For a facility-scale project, it is often the building location where the system is located. For a community-scale project, it is often the community supporting the development. For a commercial-scale project, it can be any party purchasing the electricity, typically a utility.

Operator
Provider of the day-to-day operations and maintenance of the project.

Photovoltaic
A solar resource converted to electricity.

Private Equity
Direct investment into private companies by funds and investors.

Production Tax Credit
A federal tax incentive for renewable energy based on the electrical output of the project in kilowatt-hours.

Sale Leaseback
Renewable energy project financing structure that allows for multiple participants in a development structure. Allows for capture of tax credit value for nontaxable entities.

Tax-Equity Partner
A project development partner with a tax appetite that can take advantage of existing tax credits for renewable energy projects at the federal and state level.

Executive Summary

This paper provides an overview of existing and potential financing structures for renewable energy project development in Alaska with a focus on four primary sources of project funding: government financed or supported (the most commonly used structure in Alaska today), developer equity capital, commercial debt, and third-party tax-equity investment. While privately funded options currently have limited application in Alaska, their implementation is theoretically possible based on successful execution in similar circumstances elsewhere. This paper concludes that while tax status is a key consideration in determining appropriate financing structure, there are opportunities for both taxable and tax-exempt entities to participate in renewable energy project development.

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1. Introduction

Alaska's Native villages and corporations are uniquely positioned to take advantage of renewable energy development opportunities given the large amount of land and energy resources they control. High retail electricity rates,[1] an abundance of renewable energy resources, and dependence upon diesel generators within remote communities (Energy Information Administration [EIA] 2012c) make renewable energy development attractive. In order to leverage these favorable market conditions and realize Alaska's potential for renewable energy generation, use of both government-sponsored and private financing opportunities is necessary. The purpose of this paper is to provide an introduction to a variety of ways in which tribal and corporate entities may participate in the development of renewable energy projects in Alaska. While not intended to be a comprehensive guide to the detailed nuances of renewable energy financing, this paper provides an introduction to the topic and directs readers to further resources and more detailed information on the subject matter contained herein.

The remainder of this report is structured as follows:

Section 2 provides background on the scale of the potential for renewable energy development in Alaska. This resource-based overview illustrates that although current development is limited, there is a large opportunity for reaping the benefits of renewable energy if financing and other barriers can be overcome. A detailed methodology for determination of technical potential in Alaska is listed in Appendix A.

Section 3 provides an overview of two federal tax incentives, the capturing of which is often critical to establishing viable economics for project development. These incentives are relevant to both taxable and nontaxable entities as private financing structures have arisen to facilitate capturing of the benefits of the tax incentives (and therefore favorable project economics) by nontaxable entities (further described in Section 7).

Section 4 provides an understanding of the state energy policy context, which is critical as these policies create the structure in which renewable energy financing structures exist.

Section 5 provides an overview of the federal and state publicly funded financing options in Alaska, which are the most commonly used mechanisms for project development to date. Appendix B contains a comprehensive table of government-sponsored financing programs.

Section 6 offers a summary of potential private options for financing projects by and for taxable entities, as well as examples where applicable.

Section 7 outlines the concept of tax-equity partnership financing options for nontaxable entities and outlines opportunities for different stakeholders in Alaska.

Section 8 provides a brief concluding overview of the options for development of renewable energy projects in Alaska.

[1] Alaska has the second highest electricity rates in the nation, approximately 163% of the national average (EIA 2012a). Rural parts of Alaska, however, have significantly higher rates of $0.50/kWh or more, with diesel-generated electricity exceeding $1/kWh in several remote villages (Union of Concerned Scientists [UCS] 2009).

2. Technical Potential

Although there are vast renewable energy resources in Alaska, it is not technically feasible to develop all available resources. A technical potential analysis estimates the resources that can be used for renewable energy generation based on commercially available technologies, developable land, and system performance. It reduces the raw resource potential by removing lands that have unusable slopes or are on water, and by incorporating technological limitations (e.g., capacity factors at the geographic location in question (Figure 1). The technical potential analysis can be further refined by incorporating technology and fuel costs to provide an estimate of what is economically feasible to develop (or the “economic potential”). Applying market specifics, such as policy and regulatory limits, to the economic potential provides an estimate of the market potential for a specific area.

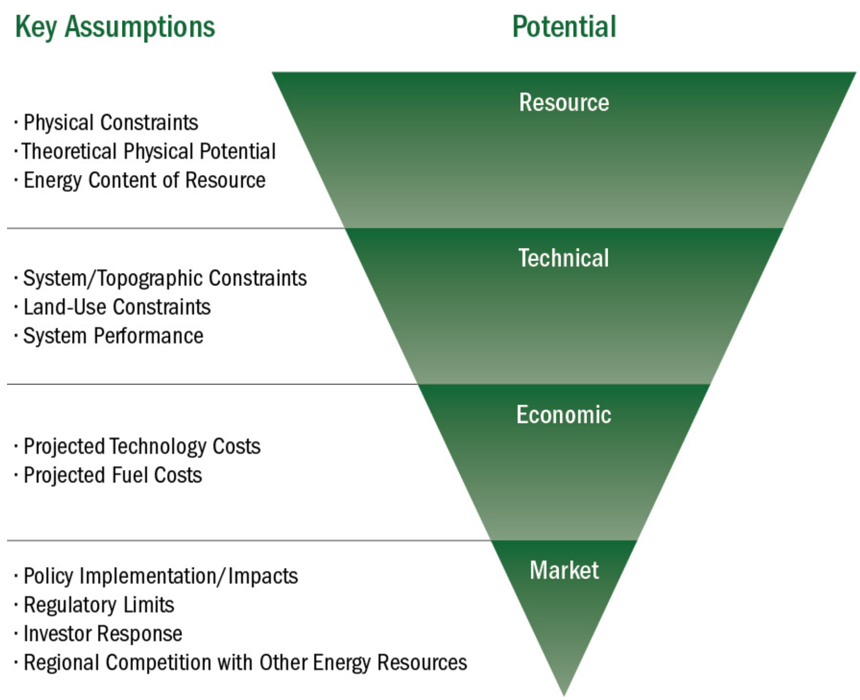


Figure 1. Levels of renewable energy potential defined

Source: Lopez et al. 2012, adapted from the DOE Office of Energy Efficiency and Renewable Energy (EERE) 2006

Technical potential may not reflect the developable potential because it does not incorporate technology costs; competing land uses; transmission and infrastructure availability; or the policy, investor, or energy competitive environments. However, it is included below to provide a better understanding of the technical potential for renewable energy development on Alaska Native corporation (ANC) lands for different renewable energy resources.

Alaska is particularly well suited for wind and geothermal energy development but also exhibits the technical potential and resources necessary to develop photovoltaic (PV) energy, hydropower, and biopower. The technical potential for various renewable energy resources on ANC lands is listed in Table 1. The technical potential estimates were calculated using geospatial analysis based on the methodology listed in Appendix B. The strength of using geospatial analysis to estimate technical potential is that it provides an idea of the specific locations of the resource that is technically available. However, this analysis does not allow for the consideration of on-site load or the ability to transmit the generation to load in a distant location. Alaska is unique in that there are vast areas that the transmission grid does not reach. As a result, locations with high renewable energy potential may not be able to transmit generation to the grid, essentially stranding renewable resources (analysis on this topic is forthcoming [Johnson et al.]).The geospatial analysis used in this report cannot incorporate the impacts of microclimates, which are understood to be prevalent in Alaska and can create challenges for developing renewable electricity generation. The technical potential analysis focuses solely on electricity generation and does not address thermal potentials, but there are thermal renewable energy opportunities in Alaska as well (e.g., biomass used for heating).

The technical potential analysis below builds on existing renewable energy analyses such as the *Renewable Energy Atlas of Alaska* (AEA 2011) and *Renewable Energy and Energy Efficiency in Alaska* (Hirsch forthcoming). The *Renewable Energy Atlas* provides an overview of the state's energy infrastructure and renewable energy resource potential. This report builds on the *Renewable Energy Atlas* by narrowing down to the technical potential and estimating the potential that exists within the boundaries of each ANC. Figure 2 shows the boundaries used to analyze the technical potential of ANCs.

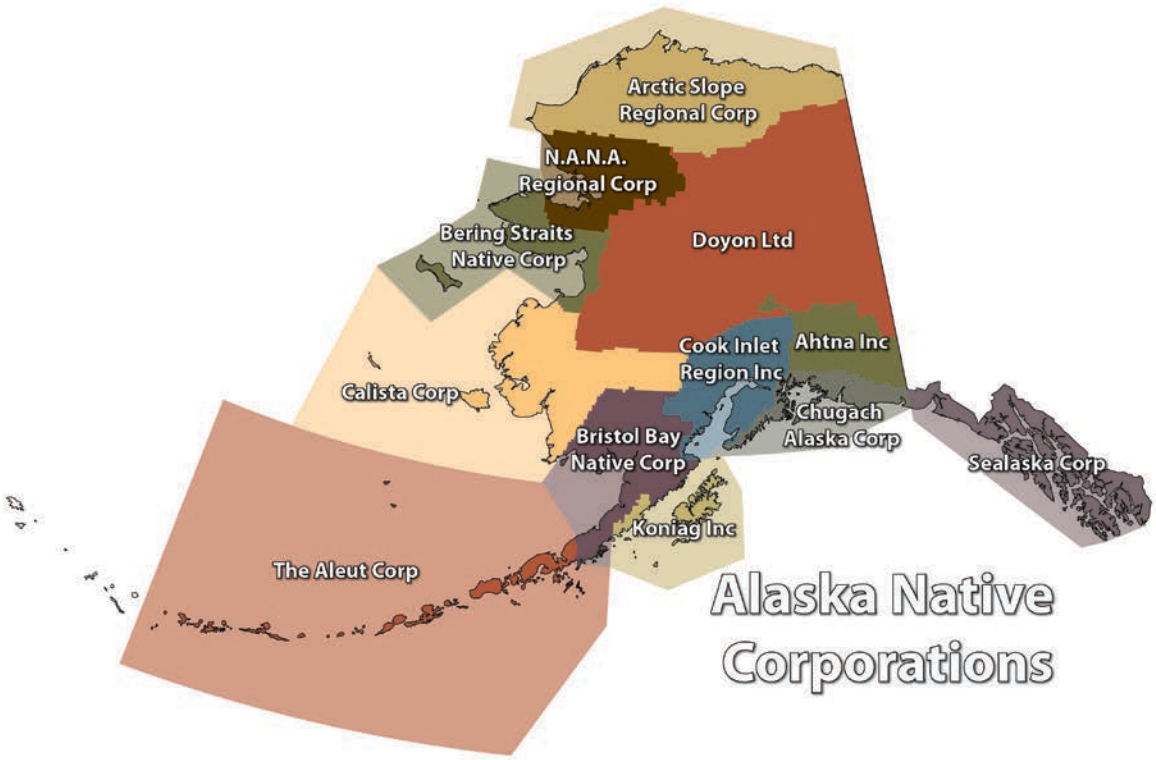


Figure 2. ANC boundaries for technical potential analysis

Table 1. Technical Potential for Various Renewable Energy Resources on Alaska Native Corporation Lands

	Utility-Scale PV (GWh)	Hydropower (GWh)	Wind (GWh)	Solid Biopower (GWh)	Gaseous Biopower (GWh)	Geothermal Hydrothermal (GWh)
Ahtna Inc	459,632.4	4,494.5	15,549.6	2.2	0.1	10.6
Arctic Slope Regional Corp	3,831,278.4	207.0	2,278.4	0.8	0.1	-
Bering Straits Native Corp	583,633.6	121.6	100,918.8	1.1	0.1	-
Bristol Bay Native Corp	1,335,744.2	552.1	17,551.5	1.8	0.1	-
Calista Corp	718,295.4	749.7	246,798.2	3.2	0.2	-
Chugach Alaska Corp	107,729.0	542.6	52,422.7	3.8	4.8	-
Cook Inlet Region Inc.[2]	440,530.4	6,799.7	15,228.9	36.8	54.8	18.3
Doyon Ltd	3,339,765.3	7,346.1	62,864.1	75.1	0.9	726.4
Koniag Inc	13,049.2	93.9	252,216.2	1.3	0.1	22.2
N.A.N.A. Regional Corp	583,866.3	193.7	250,904.2	0.8	0.1	136.6
Sealaska Corp	171,110.9	2,573.2	340,424.5	385.6	0.6	219.6
The Aleut Corp	101,479.8	1.3.0	20,287.1	0.9	0.1	3,401.2
Total	11,686,114.7	23,675.6	1,377,444.1	513.5	61.8	4,535.0

For comparison, the total amount of retail electricity sales in 2010 in Alaska was 6,247 GWh (EIA 2012b).

[2] Cook Inlet Region Inc. is the only ANC with technical potential for utility-scale PV in an urban setting. All other ANCs only have technical potential for utility-scale PV in rural settings. The assumptions used to calculate the technical potential for utility-scale PV in urban and rural settings are different, based on industry standards for land availability requirements. The technical potential for urban and rural utility-scale PV has been combined in this table for Cook Inlet Region Inc.

3. Federal Production and Investment Tax Credits

Federal incentives play an important role in the commercialization and adoption of renewable energy technologies by providing consistent financial support for growth, including the construction of manufacturing plants and investing in projects that require extended planning and construction time. For the commercial, industrial, utility, and agricultural sectors, the U.S. government currently supports renewable energy deployment through the Production Tax Credit (PTC), Investment Tax Credit (ITC), and New Market Tax Credit (NMTC), which encourage private investment by reducing taxes owed by a project owner. While the NMTC is available beginning in the year in which the investment is made, the ITC is available to the taxpayer in the year the energy project is placed into service and the PTC is available as electricity is produced. In addition to these tax credits, the government provides depreciation benefits through the Modified Accelerated Cost Recovery System (MACRS), which enables certain investments in wind, geothermal, and solar technologies to be recovered over a 5-year schedule in lieu of the standard life of the asset. MACRS improves the economic viability of a project by reducing tax liability in the initial years of production.

Together, these are referred to as the “federal tax benefits” and can represent approximately 50% to 55% of an eligible project’s initial installed cost (Mendolsohn and Feldman 2012). However, renewable energy developers often lack sufficient taxable income to directly monetize these tax benefits, requiring that the project’s financial structure include third-party tax-equity investors or that the project be developed by entities with sufficient taxable income from other enterprises. (See Section 7 for further information on tax-equity partnerships.)

Production Tax Credit—Companies that generate electricity from landfill gas, wind, biomass, hydroelectric, geothermal electric, municipal solid waste (MSW), hydrokinetic power (i.e., flowing water), anaerobic digestion, tidal energy, wave energy, and ocean thermal sources are eligible for the PTC during the first 10 years of renewable energy production. Hybrid wind-diesel systems are also eligible. The PTC is only available to grid-connected sources and is inflation adjusted (currently set at 2.2¢/kilowatt-hour [kWh] for wind, geothermal, and closed-loop biomass and 1.1¢/kWh for all other eligible technologies); see Table 2. For the wind industry in particular, the PTC has been a major driver of increased installed capacity throughout the United States. On January 1, 2013, the PTC for wind, incremental hydro, wave and tidal energy, geothermal, and bioenergy was extended until December 31, 2013. Furthermore, facilities utilizing these technologies no longer have to be in production to qualify for the credit; the requirement has been relaxed to include projects under construction before January 1, 2014. Despite the extension, the pending expiration of the PTC continues to influence financing structures, as some developers will limit debt in the capital stack to avoid transaction delays and meet under-construction deadlines. For more information on PTCs, see Harper et al. 2007, available online at http://eetd.lbl.gov/ea/emp/reports/63434.pdf and the Database for State Incentives for Renewables and Efficiency (DSIRE) available online at http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US13F&re=1&ee=1.

Table 2. Production Tax Credit Expiration Schedule and Value

Resource Type	Under-Construction Deadline	Credit Amount
Wind	December 31, 2013	2.3¢/kWh
Closed-Loop Biomass	December 31, 2013	2.3¢/kWh
Open-Loop Biomass	December 31, 2013	1.1¢/kWh
Geothermal Energy	December 31, 2013	2.3¢/kWh
Landfill Gas	December 31, 2013	1.1¢/kWh
Municipal Solid Waste	December 31, 2013	1.1¢/kWh
Qualified Hydroelectric	December 31, 2013	1.1¢/kWh
Marine and Hydrokinetic (150 kW or larger)	December 31, 2013	1.1¢/kWh

Source*:* DSIRE

Investment Tax Credit—Section 48 of the Internal Revenue Code provides an Investment Tax Credit for certain types of energy projects which reduces a company's tax liability by a percentage of qualified capital expenditures. The credit is allotted in the year in which the project begins commercial operations and vests linearly over a 5-year period (i.e., 20% of the 10% geothermal credit vests each year over a 5-year period). If the project owner sells the project before the end of the 5-year period, the unvested portion of the credit will be recaptured by the Internal Revenue Service. Technologies eligible for the ITC include solar, fuel cell, small wind, geothermal, microturbine, and combined heat and power (CHP). In 2009, Congress expanded the availability of the ITC under the American Recovery and Reinvestment Act (ARRA) by allowing developers to elect the ITC in lieu of the PTC for PTC-eligible technologies (see Table 2 and Table 3). As a result of overlapping eligibility for the PTC and ITC, certain technologies, such as geothermal and CHP, are eligible for the 30% ITC until the PTC expires on December 31, 2013. Upon expiration, the ITC for these dual eligible technologies will revert back to 10% until the ITC expires. In 2010, federal legislation was enacted that allowed assets placed in service from 2009 through 2012 to receive a cash grant in lieu of the tax credit from the Treasury Department (1603 Cash Grant). While the 1603 Cash Grant program has expired, it is worth noting as it is highlighted as a financing tool in a subsequent example within this paper. For more information on ITCs, see Sharif et al. 2011, available online at http://www.cohnreznick.com/insights/white-papers and DSIRE http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US02F&re=1&ee=1.

Table 3. Investment Tax Credit Expiration Schedule and Value

Resource Type	Deadline Type	Date	ITC Amount
Solar	In Service	12/31/2016	30%
Fuel Cells (≥0.5 kW)	In Service	12/31/2016	30%
Small Wind Turbines (≤100kW)	In Service	12/31/2016	30%
Geothermal Systems	In Service	12/31/2016	10%
Microturbines (≤2 MW)	In Service	12/31/2016	10%
Combined Heat and Power (CHP) (≤50 MW)	In Service	12/31/2016	10%
PTC Eligible Technologies[3]:			
Wind	Begin Construction	12/31/2013	30%
Closed-Loop Biomass	Begin Construction	12/31/2013	30%
Open-Loop Biomass	Begin Construction	12/31/2013	30%
Geothermal Energy	Begin Construction	12/31/2013	30%
Landfill Gas	Begin Construction	12/31/2013	30%
Municipal Solid Waste	Begin Construction	12/31/2013	30%
Qualified Hydroelectric	Begin Construction	12/31/2013	30%
Marine and Hydrokinetic (≥150 kW)	Begin Construction	12/31/2013	30%

Source: DSIRE

New Market Tax Credit (NMTC)—The NMTC was enacted by Congress as part of the Community Renewal Tax Relief Act of 2000 to create jobs and improve the lives of residents in low-income communities[4] and target populations.[5] It allows individual and corporate taxpayers to receive a federal income tax credit for making qualified equity investments in qualified community development entities (CDEs). CDEs must be designated by the Community Development Financial Institutions (CDFI) Fund, which is a division of the U.S. Department of the Treasury. The NMTC equals

[3] The American Recovery and Reinvestment Act of 2009, which allows PTC-eligible facilities to use the 30% ITC, has implications for some technologies that were already potentially eligible for either incentive in some form. Certain geothermal and open- or closed-loop biomass systems (which may include certain types of biomass CHP projects) now qualify for a 30% tax credit through December 31, 2013, the begin-construction deadline for these technologies under the PTC. Wind-energy systems of all sizes—not only systems of 100 kW or less—also now qualify for the 30% ITC through the wind-energy PTC begin construction deadline of December 31, 2013. Applicants should refer to the eligibility definition contained in the PTC to determine if and how their project might qualify for this treatment.

[4] IRC §45D defines low-income community as "any population census tract where the poverty rate for such tract is at least 20% or in the case of a tract not located within a metropolitan area, median family income for such tract does not exceed 80 of statewide median family income, or in the case of a tract located within a metropolitan area, greater of statewide median family income or the metropolitan area median family income" (U.S. Department of the Treasury 2013).

[5] The American Jobs Creation Act of 2004 amended IRC §45D(e)(2) to make targeted populations eligible for the NMTC. A targeted population is defined as "individuals, or an identifiable group of individuals, including an Indian tribe, who are low-income persons or otherwise lack adequate access to loans or equity investments"(U.S. Department of the Treasury 2010). Targeted population also includes the Hurricane Katrina Gulf Opportunity (GO) Zone.

39% of the investment and is claimed over a 7-year period. Through 2011, CDFI Fund made 664 awards worth a total of $33 billion. The Coastal Community Action Program (CCAP) provides an example of the NMTC in practice. CCAP is a nonprofit social services agency in Washington that relies heavily on federal and state funding and charitable donations to operate. In 2010, CCAP constructed a 6 MW wind farm with the help of a state grant and $8 million in NMTC financing, provided by a community development entity located in Oregon (New Markets Tax Credit Coalition 2012). It is estimated that the project provided low-cost electricity to 10,000 low-income families and created or retained 30 jobs. For more information on the NMTC, see http://www.irs.gov/pub/irs-utl/atgnmtc.pdf and http://cdfifund.gov/what_we_do/programs_id.asp?programID=5 for information on the CDFI Fund.

3.1 Tax Credit Eligibility

The ability to monetize the full value of tax benefits is a key consideration when deciding a project's capital structure. Project owners, also referred to as developers, are eligible to receive federal tax credits. Only taxable entities, such as Alaska Native corporations, can take advantage of tax benefits directly, while tax-exempt entities, such as tribal and municipal governments, cannot. Thus, if tax credits are being used for project financing, taxable entities must retain ownership of the project for the duration of the tax credit period. When tax benefits are no longer available to the project, asset ownership can be transferred to tax-exempt tribal entities without concern over loss of available financing. For example, consider a taxable ANC that develops a wind project with the use of the Production Tax Credit. The duration of the PTC for wind projects is 10 years. After 10 years, when tax credits are no longer available to the project, ownership can be transferred from the ANC to a tax-exempt tribal government or other tribal entity. In this scenario, the ANC and the tribal government form a partnership in which, for the first 10 years of the project (the tax credit period), the ANC benefits from the decreased tax liability, while the tribal entity benefits from the project's revenue stream for the remainder of the life of the asset (see Section 7).

At the onset of project development, it must first be determined whether the developer has sufficient tax appetite to monetize the tax benefits available, which requires profits from other components of the owner's business. Otherwise, a third-party tax-equity investor is needed to make use of the tax benefits efficiently. Currently, the market for tax-equity investors generally consists of a few large banks and insurance companies willing to invest a minimum of $15 million to $30 million per project (Mendolsohn and Feldman 2012). Given the high investment required of tax-equity investors, ANCs are more likely to participate in renewable energy finance as a project developer or owner, not as a tax equity investor. ANCs can seek tax-equity investment for their projects under development, though this is not necessary for large ANCs that have the tax appetite to monetize the ITC themselves. Entities such as tax-exempt tribal and municipal governments and nonprofit rural electric cooperatives that are unable to fully utilize the available tax benefits can partner with ANCs to take advantage of the tax benefits through innovative financing mechanisms (see Section 7). While tax status is a key consideration in determining the appropriate financing structure, both taxable and tax-exempt entities can participate in renewable energy project development, albeit through different financing arrangements.

4. State Policy Context for Renewable Energy Development

In order to better understand the context for renewable energy development in Alaska, this section summarizes state-level nonfinancial incentive policies supporting renewable energy development. State-level policies are often used to support renewable energy development because the benefits of renewable energy are considered to be public goods that will not be automatically captured by private markets. These policies are often considered drivers or barriers to renewable energy development. The state also offers several financial incentives through policy action, and those are listed in Section 5 as they are a subset of the publicly available project financing options.

The State of Alaska currently has 16 policies focused on renewable energy and energy efficiency, 12 of which are financial incentives (DSIRE 2012). In comparison with other states, Alaska ranks 48th in terms of the number of policies supporting energy efficiency and renewable energy, with only Kansas and West Virginia offering fewer policies. The four nonfinancial policies are discussed in the remainder of this section to offer context to the development environment for renewable energy in Alaska.

One of the most common mechanisms used by state governments to support renewable energy investment is the renewable portfolio standard (RPS). An RPS is a market-based policy that requires a minimum percentage of the electricity sold by utilities to be generated with renewable energy. It is a popular policy with regulators and utilities because it does not prescribe specific purchases or technology use, therefore allowing the requirements to be met with the least-cost solution. The RPS is also a popular tool for policymakers because it encourages market development through private sector investment. Indeed, RPS policies have been shown to be positively correlated with increased renewable energy market development (Krasko and Doris 2012).

Several states, including Alaska, have legislated a form of a voluntary goal for additional renewable energy development called a renewable energy goal. There is no evidence that these types of goals—in the absence of a requirement expected at a certain date in the future (such as in Vermont)—are effective at driving new or previously unplanned renewable energy development. Alaska's renewable energy goal was established with House Bill 306 (2010) stating a legislative intent that the state "achieve a 15 percent increase in energy efficiency on a per capita basis between 2010 and 2020" and "receive 50 percent of its electric generation from renewable and alternative energy sources by 2025."

The other main policies in Alaska focused on renewable energy include the state's net-metering regulations, interconnection guidelines, and the Alaska Renewable Energy Fund (AREF). The AREF is a state grant program and is discussed in Section 5. The net-metering regulations require all utilities with retail sales of at least 5 gigawatt-hours (GWh) to offer net metering to their customers for renewable energy systems up to 25 kilowatts (kW) in capacity. Net excess generation (NEG) is reconciled each month, with the utility issuing the customer a credit for NEG. Freeing the Grid, an annual scorecard rating state-level net-metering and interconnection standards, gives Alaska's net-metering regulations a "C," citing the arbitrary system size limits not based on on-site load, monthly NEG reconciliation instead of indefinite NEG carryover, and ambiguity regarding renewable energy credit (REC) ownership as areas that reduce the impact of this policy on driving investments in renewable energy generation. The state's interconnection guidelines mandate that all utilities that are required to offer net metering must also issue tariffs incorporating interconnection. However, the guidelines provide limited direction to the utilities about designing interconnection standards. As a result, the authors of the 2012 Freeing the Grid report do not consider the guidelines to be complete interconnection standards and thus do not provide an assessment of the guidelines. General summary information about these two policies and others in Alaska can be found at http://dsireusa.org/incentives/index.cfm?re=0&ee=0&spv=0&st=0&srp=1&state=AK.

While interconnection and net-metering policies are considered to be valuable for encouraging investment in renewable energy technologies at the state level, it is important to note that the impacts of these policies in Alaska may vary, particularly for small, isolated grids.

5. Publicly Sponsored Finance Programs for Taxable and Nontaxable Entities

Federal and state-sponsored finance programs come in a variety of forms and are generally suitable for small to medium-sized projects, typical among Alaska's Native villages. They commonly exist as grants, loans, and loan guarantees. While most of the programs offered, such as the AREF, are available to both taxable and tax-exempt organizations, it is not always the case. For example, taxable entities, such as Alaska Native corporations, may be eligible for financial assistance programs under the Federal Small Business Act due to their profit-seeking tax status, while tax-exempt organizations are not. Therefore, it is important to determine program eligibility when considering financing options. The remainder of this section provides an overview of some of the most commonly used publicly funded financing programs, and a full list can be found in Appendix B.

Alaska Renewable Energy Fund—In 2008, the Alaska state legislature established the Renewable Energy Grant Program to provide assistance to utilities, independent power producers, and local and tribal governments for the purpose of developing renewable energy projects. In accordance with the bill, the state intends to distribute as much as $50 million per year until 2023. However, it is important to note that actual appropriations have varied, since each round of funding is subject to the governor's approval. In May 2012, the governor approved $26 million for Fiscal Year 2013 (State of Alaska 2012). Funds may be used for a variety of projects, including feasibility studies, energy resource monitoring, and work related to the design and construction of eligible facilities. The program is administered by the Alaska Energy Authority (AEA) and accepts solicitations on an annual basis. In 2009, Unalakleet Village Electric Cooperative, Unalakleet Village Corporation, and Norton Sound Economic Development Corporation partnered with STG Incorporated and Northern Power Systems to develop a 600-kW wind farm as one of the first projects to be completed with funding from the grant program. The project cost approximately $9 million to complete, with $4 million from the AEA. Since inception, the wind farm has generated 2.8 million kWh of energy and saved an estimated 212,000 gallons of diesel fuel (Northern Power Systems 2012). The Renewable Energy Fund also supports hydropower development. In 2010, the community of Gustavus generated 99% of its electricity from hydropower after replacing a diesel generator with an 800-kW hydroelectric generator (Alaska Energy Authority 2011). The project was made possible by a $750,000 grant from the AREF, and it eliminated the need for $380,000 of diesel in one year.

Alaska Industrial Development Export Authority (AIDEA) Loan Program—With the goal of promoting economic and energy infrastructure development, in June 2012 Gov. Sean Parnell signed Senate Bill 25, the Alaska Sustainable Strategy for Energy Transmission and Supply (ASSETS). The bill established a new fund within AIDEA for financing energy development throughout the state and enables AIDEA to issue loans directly to borrowers for energy projects, or partner with banks or credit unions. AIDEA will also be able to insure project obligations by offering a loan or bond guarantee.

SBA 7(a) Loan Program—To facilitate lending to small businesses, Congress established the 7(a) Loan Program under the Small Business Act. The program provides loan guarantees to for-profit businesses that are otherwise unable to secure funds through traditional lending. In order to qualify for the program, a business must meet industry-specific size limitations. If the business is eligible, the Small Business Administration (SBA) will guarantee a maximum of 85% of the loan amount on loans up to $5 million. The proceeds may be used for a wide variety of business purposes, and repayment periods may extend up to 25 years.

Qualified Energy Conservation Bonds (QECB)—In 2008, Congress authorized the issuance of $800 million in tax credit bonds by state, local, and tribal governments to finance qualified energy conservation projects. In 2009, ARRA increased the authorized amount to $3.2 billion. QECB allocations across states are based on population, and as of January 30, 2012, 28 states, including Alaska, had yet to utilize available funds (Bellis 2012). When surveyed, states indicated that they had not utilized the program due to high transaction costs associated with small allocations, debt aversion, and lack of awareness.

Alongside these programs, the Denali Commission is also very active in supporting renewable energy deployment. The Denali Commission was created by Congress in 1998 to facilitate the efficient deployment of federal services in the State of Alaska, to promote economic development in rural and distressed communities, and to improve infrastructure, such as water and sewer systems, power generation and transmission facilities, and communication systems within the state (Denali Commission Act of 1998). To ensure that local interests are represented, the Denali Commission comprises representatives from a variety of organizations, such as the University of Alaska, the Alaska Federation of Natives, and the Alaska Municipal League. The commission is co-chaired by the governor of the State of Alaska and an appointee of the secretary of commerce. Together, the commission is an independent federal agency with the authority to procure federal funding from Congress and a variety of federal agencies, such as the U.S. Department of Agriculture (USDA).

USDA Rural Development (USDA-RD) has a $181.1 billion loan portfolio and expects to administer $38 billion in loans, guarantees, and grants during this fiscal year (USDA Rural Development 2013). The USDA-RD Rural Energy for America Program (REAP) offers several grant opportunities, including: 1) the Energy Audit and Renewable Energy Development Assistance Grant 2) the Renewable Energy System and Energy Efficiency Improvement Guaranteed Loan and Grant Program and 3) the Feasibility Studies Grant. RD also provides the High Energy Cost Grant, focused on assisting communities where expenditures for home energy exceed 275% of the national average. For general information on REAP grants, see http://www.rurdev.usda.gov/RD_Grants.html. For information on the High Energy Cost Grant Program see http://www.rurdev.usda.gov/UEP_Our_Grant_Programs.html.

The USDA Rural Utility Service (RUS) Electric Program makes direct loans and loan guarantees, but to electric utilities that serve customers in rural areas. RUS loans and loan guarantees finance the construction of electric distribution, transmission, and generation facilities, including system improvements and replacements. For more information on RUS Electric Program, see http://www.rurdev.usda.gov/UEP_About_Electric.html.

The aforementioned programs are just a few examples of the assistance programs available to developers of renewable energy projects. A more complete list can be found in Appendix B.

6. Financing Options for Taxable Entities

Due to their tax-paying status, Native corporations in Alaska have access to an expanded suite of private and government-sponsored financing arrangements for renewable energy projects compared to tax-exempt tribal governments and other tax-exempt entities. For the purposes of private financing, Native corporations are eligible to support traditional equity investment with tax credits and accelerated depreciation benefits for renewable energy. In terms of government-sponsored financing opportunities, Native corporations that meet the eligibility requirements for small business designation can take advantage of programs provided by the Small Business Administration, such as the SBA Loan Program.

6.1 Project Financing

Typically, either traditional project finance or balance sheet financing[6] is used for the development of large-scale renewable energy projects that exhibit sufficient rates of return to offset perceived risk and high transaction costs. While private financing often requires a relatively large project scale for economic viability, many regional Native corporations have sufficient land holdings, earnings, and project development expertise to take advantage of private financing for renewable energy development. Although larger corporations may be best suited for private financing arrangements, smaller village corporations have potential to use private financing to fund portions of larger projects or group several projects together to attract capital.

The preconstruction phase of a large-scale project is typically funded with development equity, while capital for project completion is sourced from a combination of debt (e.g., banks) and equity (e.g., private investor) investment. These private sources of capital can be used in conjunction with grants and federal and state tax credits to meet project funding requirements and bolster lender and investor confidence in overall project viability.[7] In Alaska, debt financing for large projects can be sourced through entities such as commercial banks, credit unions, the U.S. Department of the Treasury (via its lending arm, the Federal Financing Bank), and the U.S. Department of Agriculture. The Denali Commission, established by the Denali Commission Act of 1998 to deliver services of the federal government, is also very active in supporting energy and infrastructure development in Alaska and receives funding from the USDA. Loan terms and interest rates vary on a project-by-project basis, though in all cases banks are the senior creditor and are the first to be repaid. However, unlike equity investors, sources of bank debt do not retain an ownership share in the project.[8] Thus, if maintaining project ownership is a priority to the Native corporation or other developer, it is preferable to structure the project's financing such that bank debt comprises a greater share of the capital structure than equity.

6.2 Case Study: Fire Island Wind

Fire Island Wind, Alaska's first commercial-scale wind farm, provides an example of a Native corporation sourcing financing through a combination of debt, equity, and government incentives to complete a large-scale renewable energy project. Jointly developed by Cook Inlet Region Incorporated (CIRI) and Summit Power, the wind farm is located on CIRI land, three miles west of

[6] Under traditional project finance, recourse for providers of capital is limited to the assets of the project company, whereas balance sheet finance exposes the assets of the parent company as a means to satisfy financial obligations of the project company.

[7] For further information on the essentials and basics of private financing arrangements, see Renewable Energy Development in Indian Country: A Handbook for Tribes: http://apps1.eere.energy.gov/tribalenergy/pdfs/indian_energy_legal_handbook.pdf.

[8] Note: Debt, while not ownership, has collateral claims on a project and can be required to approve major decisions in the day-to- day management and operations of a project.

Anchorage, and is owned and operated by Fire Island Wind LLC, a wholly owned subsidiary of CIRI. Originally envisioned as a three-phase project, the first phase went into commercial operation in September 2012 and includes 11 1.6-megawatt (MW) turbines capable of producing 17.6 MW of electricity, enough to power more than 6,000 homes. With a 25-year power purchase agreement (PPA) with Chugach Electric Association for a flat price of $97 per megawatt-hour (MWh), Fire Island Wind will diversify south-central Alaska's electricity generation mix, which currently comprises more than 90% natural gas.

For the first phase of the project, Fire Island Wind LLC used a bridge loan for a portion of the construction financing requirements in anticipation of receipt of a 1603 Treasury Department grant in the amount of $19 million.[9] The original projected total capital cost for Fire Island Wind's three phases was $162.2 million, of which $43.9 million would be supported by the 1603 grant program. However, now that the 1603 grant program is no longer available, it remains to be seen how the residual $24.9 million in anticipated grants for the remaining two phases will be financed, should the project move forward. It is possible that a combination of sources, including the ITC, could be used.

Original plans call for the remaining net project costs to be financed with debt from CoBank, in the amount of $81.6 million and equity investment by CIRI in the amount of $36.7 million. As of November 2012, no work has begun on the second and third phases of the project.[10] See Table 4 and Table 5 for a summary of estimated project costs and project financing.

Table 4. Fire Island Wind Estimated Project Cost (phases 1, 2, and 3)

Item	Cost (million $)
Wind Turbines/Parts/Transport	82.0
Balance of Plant/ Construction/Contingency	46.0
Permitting/Construction Mgmt./Predevelopment Costs/Legal/Taxes/Insurance	23.4
Total	151.4
Allowance for Funds Used During Construction (int. During Construction)	10.8
"All in" Financed Cost at COD	162.2

Source: CIRI. Fire Island Wind Project. Presentation to Mayor's Energy Task Force. November 2, 2010. Available online at http://www.mlandp.com/redesign/Energy_Topics/CIRI.Mayors%20Task%20Force.11.3.10.pdf

Table 5. Fire Island Wind Estimated Project Financing (phases 1, 2, and 3)

Item	Cost (million $)
Approx. Project Capital Cost (excludes $25 M interconnect):	162.2
Approx. ARRA Sec. 1603 Grant:	43.9
Est. Net Project Cost	118.3
Amt. Financed—Debt (all, or part, by CoBank):	81.6
CIRI Equity Investment (approx.):	36.7

Source: CIRI. Fire Island Wind Project. Presentation to Mayor's Energy Task Force. November 2, 2010. Available online at http://www.mlandp.com/redesign/Energy_Topics/CIRI.Mayors%20Task%20Force.11.3.10.pdf

[9] The Treasury 1603 grant program is a program through the American Recovery and Reinvestment Act of 2009 that allowed cash monetization of federal tax credits. Through this program, which closed for new submissions in September 2012, eligible renewable energy projects could take a cash grant in lieu of the longer-term tax incentives. The cash grant was not eligible to be received in addition to tax incentives.

[10] Information for the CIRI Fire Island Wind project is based on publicly available data and included to serve as an example, only. The development and financing for the remaining two phases of the project are not publicly disclosed as of the writing of this report.

7. Tax-Equity Partnerships

Tax-equity partnerships enable nontaxable tribal governments and Alaska Native corporations with insufficient tax liabilities to fully monetize the tax benefits available. While there are several variations of tax-equity partnership structures, all rely upon assigning project ownership to an investor with sufficient tax liability to capture available tax benefits. Financing through tax-equity partnerships differs from other financing arrangements in that it typically requires more complex transactions to allocate risk and return amongst the numerous parties involved.

Figure 3 illustrates how three common tax-equity investment vehicles fit into the capital structure of a traditional project company. Each of these three tax-equity investment structures[11]—partnership flip, sale-leaseback, and pass-through lease—are described below, with an overview of how such structures might apply to a Tribe or ANC with insufficient tax appetite to fully monetize tax benefits.

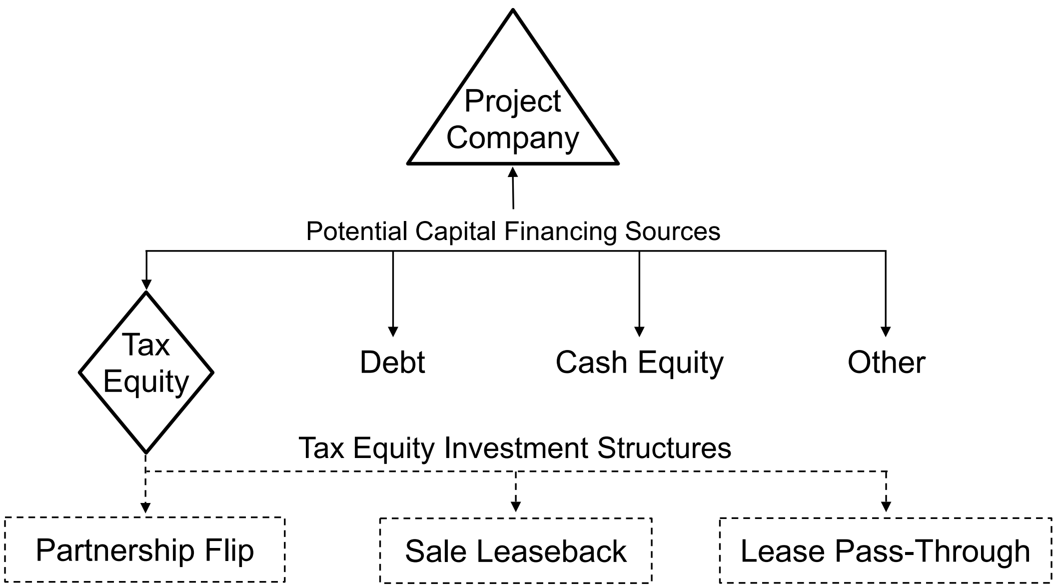


Figure 3. Capital financing sources with tax-equity investment structures

Partnership Flip—A partnership flip is a financing structure whereby the distribution of equity within a partnership between a developer and tax-equity investor is reallocated at a pre-negotiated "flip point." It is an effective method for financing renewable energy projects when a developer (i.e., ANC) lacks sufficient tax liability to fully utilize a project's tax benefits. Conversely, it is an attractive method of finance for tax-equity investors seeking to benefit from either the PTC or ITC, accelerated depreciation through MACRS, and potentially profit from project cash flows.

Under a partnership flip structure, the developer incurs the project's development cost and therefore bears the risk during this initial stage. Once development is complete, the tax-equity investor provides the capital for the project's construction, which entitles it to a majority of the project company's equity. It is not unusual for the tax-equity investor to receive 95% to 99% of the initial

[11] Under the U.S. federal tax code, these structures are subject to several limitations and requirements. Further limitations apply when a governmental or tax-exempt entity, such as a tribal government or other tribal organization, not subject to federal income tax, seeks project ownership.

equity and tax benefits (Sharif, Grace, and Di Capua 2011). Indeed, the allocation of equity is especially important when utilizing the PTC, as it may only be used by the party producing the electricity.

Allocation of the cash flow generated by the project is negotiated separately and is calculated in a manner to achieve an agreed-upon rate of return over a set period of time for the tax-equity investor. It also allows the developer an opportunity to recoup any investment that it made in developing the project that was not subsequently recovered through the tax-equity investor's capital contribution. Once the required rate of return is achieved for the tax-equity investor, the allocation of equity is typically reversed. This is known as the flip point and is usually timed to coincide with the expiration of the PTC in the 10th year of production or full vesting of the ITC in the 5th year. Should the developer wish to buy out the tax-equity investor's remaining share after the flip, it must do so at fair market value. However, it is important to note that at this point the flip has already occurred, therefore, the remaining share of equity held by the tax-equity investor may be 5% or less. Figure 4 depicts a typical partnership flip structure.

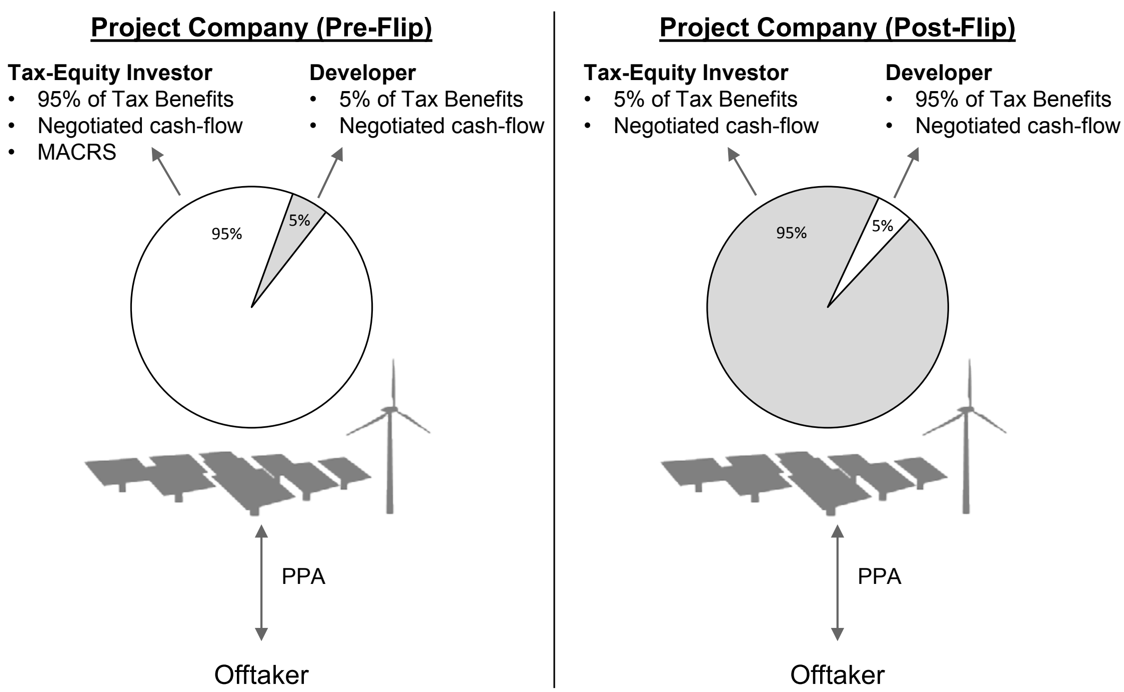


Figure 4. Example of partnership flip structure

As a result of this structure, the tax-equity investor realizes immediate returns on its investment by receiving the majority of initial cash flows and nearly all of the tax benefits. The developer's return on investment is delayed until after the flip point, at which time it consists mainly of cash flow as most of the tax benefits will have already been utilized by the tax-equity investor. However, the developer benefits in the short term by avoiding the booking of long-term construction debt on the company balance sheet and receiving enough pre-flip cash flows to recoup initial development costs.

Current federal tax rules stipulate that when a partnership includes a tax-exempt entity, a portion of the property owned by the partnership will be treated as "tax-exempt use property."[12, 13] This restricts the full monetization of tax credits and increases the period of depreciation, thereby decreasing the level of investment a tax-equity investor is willing to make. However, under IRC § 168(h)(6)(F) a tribal government can potentially avoid tax-exempt use property treatment by holding its partnership ownership interest in a taxable corporate subsidiary. A drawback of this approach is that forming a taxable corporate subsidiary may result in a higher tax burden, and the application of these rules to a Tribe are not well defined (MacCourt 2010). In March of 2013, the IRS released a private letter ruling (PLR-111532-11) issued to a Tribe in response to an inquiry regarding the Tribe's ability to pass the ITC to a tax-paying lessee. The IRS determined that the Tribe was eligible to claim the ITC and pass it to a lessee because the Tribe was not technically a tax-exempt entity; rather, federal income tax statutes simply did not apply to the Tribe. As such, tax code did not prohibit the Tribe from passing the ITC to a lessee because the Tribe was technically eligible to receive it itself. Under this premise, it would not be necessary to create a taxable entity to protect Tribal interest from tax-exempt use property treatment. While the issuance of the private letter ruling may suggest that other Tribes that own renewable energy projects be considered in the same manner, it is important to note that the letter only specifically applies to the Tribe that made the inquiry, and the IRS has not yet issued a Revenue Ruling or Procedure that would make it universally applicable (Hobbs Straus Dean & Walker, LLP. 2013).

Sale-Leaseback—A sale-leaseback is an effective financial technique that may be used to pass the ITC from a project's equity owner to a lessee. The PTC cannot be passed in this structure because the recipient of the PTC must be the owner and operator of the facility. In a sale-leaseback structure the developer provides the funding for the project's development and construction. When the project is ready to be put into service, the developer sells the entire project to the tax-equity investor while simultaneously signing a long-term lease agreement[14] to use the assets. The developer typically uses the proceeds from the sale to satisfy any outstanding obligations related to the project's construction and development. It is worth noting that the developer has the potential for profit or loss from the sale based upon the price received for the assets. In order to ensure that the deal is treated as a lease for federal tax purposes, most leases are arranged according to Internal Revenue Service safe-harbor provisions whereby the lease term may not extend past 80% of the project's expected useful life (Bolinger 2009). If the developer wishes to continue to use the assets at the end of the initial lease, it may negotiate a new lease or purchase the entire project from the tax-equity investor at full market value (Troutman Sanders LLP 2009, 8). Over the course of the lease, the developer remains responsible for operating the project and negotiates a power purchase agreement (PPA) with an off-taker, such as a utility. The cash flow generated by the PPA is used to cover the developer's operating costs and lease payments to the tax-equity investor. Although the tax-equity investor typically retains the right to utilize the ITC under this structure, the lessee often benefits from lower lease payments as part of the deal structure.

Similar to the tax-exempt use property considerations for partnership flips discussed above, the current federal tax code stipulates that if the project is leased to a tax-exempt entity, then it will not be eligible for the ITC and the leased property will be treated as tax-exempt use property. A Tribe may be able to avoid these restrictions by using a taxable corporate subsidiary to participate in the sale-

[12] IRC §§ 168(g) and 168(h)

[13] "The portion of the property treated as tax-exempt use property is equal to the largest ownership interest the tax-exempt partner will have in the partnership's items of income or gain during the life of the partnership." (MacCourt 2010)

[14] The two primary types of leases are capital and operating. A capital lease assumes purchase at end of lease, while an operating lease does not. Additionally, under a capital lease, the tax benefits remain with the developer.

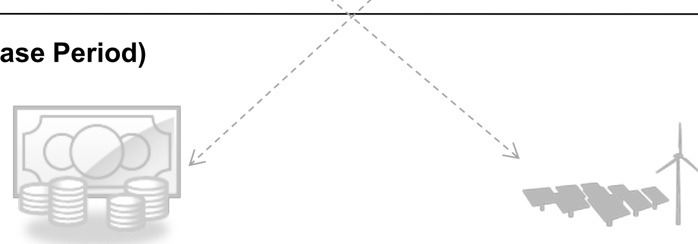
leaseback transaction. Figure 5 depicts a sale-leaseback structure according to this interpretation of the code. However, as was discussed in the partnership flip example, a recent IRS private letter ruling suggests that a taxable corporate subsidiary may not be necessary to preserve tax benefits when the lessee is a Tribe. It is important to note that the private letter ruling only applies to the specific Tribe that made the inquiry, and the IRS has not yet issued a Revenue Ruling or Procedure that would make it universally applicable (Hobbs Straus Dean & Walker, LLP 2013).

Pre-Sale

Developer
- Finances project construction
- Bears construction risk
- Provides development capital
- Owns the project

Tax-Equity Investor
- Negotiates terms of sale-leaseback with developer

Post Sale (Lease Period)



Developer
- Sells 100% of project to tax-equity investor
- Signs long-term lease to use the project for up to 80% of expected useful life
- Pays developer lower rent than market value in exchange for rights to PTC and MACRS
- Responsible for facility operation and maintenance
- Receives cash-flow from PPA
- Bears risk of operating profit/loss potential during lease

Tax-Equity Investor
- Buys 100% of project from developer
- Receives PTC, MACRS, and rent
- Provides development capital
- Owns the project
- Bears risk of profit/loss from residual project value at end of lease

Post Lease

Developer
- May negotiate new lease at fair market value
- May buy 100% of project at fair market value
- May walk away

Tax-Equity Investor
- May negotiate new lease at fair market value
- May sell 100% of project at fair market value
- May retain ownership of project

Figure 5. Example of sale-leaseback structure

Pass-Through Lease (Inverted Lease)–A pass-through lease is similar in structure to a sale-leaseback; however, the roles of lessor and lessee are reversed. Under the terms of a pass-through lease, the developer retains ownership of the project and leases the assets to the tax-equity investor. As such, this structure is only beneficial when utilizing the ITC because the PTC must remain with the facility operator. The ITC may be retained by the project owner or passed through to the lessee. In this arrangement, the tax investor would sell the electricity produced back to the developer through a PPA. The tax investor may also benefit from any losses generated by the project by owning up to 49% of the project company.[15] Under current federal tax code, this type of financing arrangement would require a tribal, tax-exempt entity to go through a corporate subsidiary for the purposes of development and project ownership. However, as was discussed in the partnership flip example, a recent private letter ruling by the IRS suggests that a taxable subsidiary may no longer be necessary; rather, a Tribe could potentially be permitted to own a renewable energy project and pass the ITC directly to a lessee. It is important to note that the private letter ruling only applies to the specific Tribe that made the inquiry, and the IRS has not yet issued a Revenue Ruling or Procedure that would make it universally applicable (Hobbs Straus Dean & Walker, LLP 2013). In the case of an Alaska Native corporation with insufficient tax liability to monetize the tax benefits, the ANC would develop and own the project, then lease to the corporate tax-equity investor with a higher tax liability. Figure 6 depicts an example of a pass-through lease structure using a project company under current federal tax code.

[15] If the project generates losses, the tax investor can use them to further offset the tax liability of income that it has from other operations.

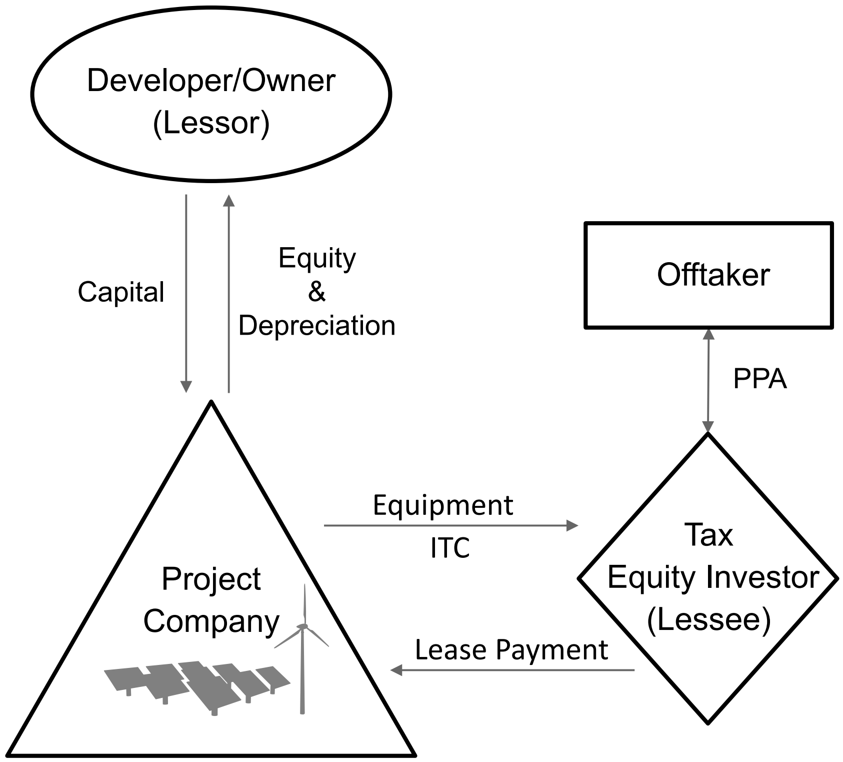


Figure 6. Example of a pass-through lease structure

8. Conclusion

There is a large potential for renewable energy development in Alaska. To date, projects in Alaska have been largely publicly financed, but there is opportunity to expand into private financing in order to capture more project potential. This paper provides a summary of publicly financed options and also outlines potential opportunities for private financing. As tax-exempt tribal entities enter into cooperative arrangements with corporate partners and investors, financing arrangements become increasingly complex. Renewable energy development often requires innovative financing structures in order to fully realize the tax benefits available and typically includes a combination of government-sponsored and private funding. Tax status, source of capital, project terms, and ownership interest are among the factors to be considered when selecting the optimal financing structure. Tax credits and accelerated depreciation are by far the most powerful government-sponsored drivers of renewable energy project development in the United States, as they attract the private capital necessary to ensure a project's economic viability. As such, there are opportunities for tribal governments and Alaska Native corporations to participate in renewable energy project development, both independently and through tax-equity partnerships.

Appendix A: Methodology for Technical Potential for Renewable Energy in Alaska

The methodology (described in detail below) mirrors the methodology applied to estimate technical potential for states in 2012 (Lopez et al. 2012), with the exception of biopower.

Biopower

To determine biopower potential, an area-weighted analysis was performed between the county-based biopower data set—used in Lopez et al. 2012—and the Alaska Native corporations layer to produce the total amount of gaseous and solid biomass of each corporation.

Total estimated technical potential generation for gaseous biomass was estimated using 4.7 MWh/tonne of CH_4 (Lopez et al. 2012). This can be expressed as:

$$Biogasgen_t = \sum \frac{AI_{p,t}}{A_p} \cdot P \cdot C$$

Where

t = distinct Alaska Native corporation
$Biogasgen_t$ = biogas generation in Alaska Native corporation *t* (MWh)
C = biogas CH_4 conversion to energy (4.7 MWh/tonne CH_4)
AI = area of intersect
P = CH_4 potential resource

Estimated capacity for gaseous biomass can be expressed as:

$$Biogascap_t = \sum \frac{AI_{P,t}}{A_p} \cdot P \cdot C \cdot CF_i$$

Where

t = distinct Alaska Native corporation
$Biogascap_t$ = biogas capacity in Alaska Native corporation t megawatt (MW)
C = biogas CH_4 conversion to energy (4.7 MWh/tonne CH_4)
CF_i = capacity factor of grid-cell *i*
AI = area of intersect
i = distinct grid-cell
P = CH_4 potential resource

Total estimated generation for solid biomass was estimated using 1.1 MWh/bone dry tonne (BDT) (Lopez et al. 2012), expressed as:

$$Biosolidgen_t = \sum \frac{AI_{p,t}}{A_p} \cdot P \cdot C$$

Where

t = distinct Alaska Native corporation
AI = area of intersect
P = BDT potential resource
$Biosolidgen_t$ = solid biomass generation in Alaska Native corporation *t* (MWh)
C = solid biomass conversion to energy (1.1 MWh/BDT)

Estimated capacity for solid biomass can be expressed as:

$$Biogascap_t = \sum \frac{AI_{P,t}}{A_p} \cdot P \cdot C \cdot CF_i$$

Where

t = distinct Alaska Native corporation
AI = area of intersect
CF_i = capacity factor for grid-cell *i*
i = distinct grid-cell
P = BDT potential resource
C = Solid biomass conversion to energy (1.1 MWh/BDT)
$Biosolidcap_t$ = solid biomass capacity in Alaska Native corporation t (MW)

Geothermal

Identified hydrothermal system source point estimates were derived from Williams et al. (2009). The source points contained capacity estimates and were overlayed onto ANC lands and summed.

Identified hydrothermal generation was estimated using:

$$Hydrothermgen_t = \sum_{Hcapa \in t} Hcapa \cdot 8760hr \cdot CF$$

Where

$hydrothermgen_t$ = hydrothermal generation in Alaska Native corporation *t* (MWh)
CF = capacity factor
Hcapa = hydrothermal source point capacity (MW)
t = distinct Alaska Native corporation

Identified hydrothermal capacity was estimated using:

$$Hydrothermcap_t = \sum_{Hcapa \in t} Hcapa$$

Where

t = distinct Alaska Native corporation
$hydrothermcap_t$ = hydrothermal capacity in Alaska Native corporation *t* (MWh)
Hcapa = hydrothermal source point capacity (MW)

Hydropower

Hydropower in this study is defined as low power (<1 MWa[16]) or small hydro (>= 1 MWa and <= 20 MWa). Hydropower source point locations with potential average capacity were taken from Hall et al. (2006). The source points were a result of a feasibility study and development model; thus no action was required on NREL's part to determine technical feasibility.

To estimate technical potential capacity, the hydropower source points were intersected with tribal lands, summed by Tribe and doubled. The doubling backs out the assumed capacity factor in the average capacity. Technical potential capacity can be expressed as:

$$Hydrocap_t = \sum_{Pcapa \in t} Pcapa \cdot 2$$

Where

t = distinct Alaska Native corporation
$Hydrocap_t$ = hydropower capacity in Alaska Native corporation *t* (MW)
Pcapa = hydropower source point average capacity (MWa)

Technical potential generation was estimated by maintaining the existing capacity factor in the average capacity and adding the time component, expressed as:

$$Hydrogen_t = \sum_{Pcapa \in t} Pcapa \cdot 8760hr$$

Where

t = distinct Alaska Native corporation
$Hydrogen_t$ = hydropower generation in Alaska Native corporation *t* (MWh)
Pcapa = hydropower source point average capacity (MWa)

[16] Average megawatt capacity; assumes 50% capacity factor.

Concentrating Solar Power

Concentrating solar power (CSP) is a utility-scale solar power plant in which the solar heat energy is collected in a central location. To get a general sense of CSP potential, CSP resource is analyzed. CSP resource is typically measured using direct normal irradiance (DNI)[17] as kilowatt-hours per square meter (m) per day (kWh/m²/day). In this analysis, we consider viable only areas with DNI greater than or equal to 5 kWh/m²/day (Lopez et al. 2012).

Further reducing developable land was needed to ensure a more realistic potential. The first step was to remove areas with slope greater than or equal to 3%. Next, areas with land-use/land-cover deemed unlikely for development were excluded. Last, areas were constrained to tribal lands and a minimum contiguous area threshold of 1 square kilometer was imposed to ensure a utility-scale system.

With developable lands defined, a specific CSP system was defined and capacity and generation estimated. The system chosen was a trough, dry-cooled with six hours of storage and a solar multiple of 2.[18] The assumed system power density was 32.8 MW per kilometer squared (Lopez et al. 2012). Technical potential capacity was expressed as:

$$CSPcap_t = \sum_{i \in t} A_i \cdot PD$$

Where

t = distinct Alaska Native corporation
$CSPcap_t$ = CSP capacity in Alaska Native corporation *t* (MW)
A_i = square kilometers of available land in grid-cell *i*
i = distinct grid-cell
PD = power density (32 MW/km^2)

To estimate generation potential, the DNI resource was divided into five classes. Capacity factors were taken from Lopez et al. 2012. Technical potential generation was then calculated and can be expressed as:

$$CSPgen_t = \sum_{i \in t} CSPcap_t \cdot 8760hr \cdot CF_i$$

Where

t = distinct Alaska Native corporation
$CSPgen_t$ = CSP generation in Alaska Native corporation t (MWh)
$CSPcap_t$ = CSP capacity in Alaska Native corporation t (MW)
i = distinct grid-cell
CF_i = capacity factor for grid-cell i

[17] The amount of solar radiation received per unit area by a surface that is always held perpendicular (or normal) to the rays that come in a straight line from the direction of the sun at its current position in the sky.

[18] The field aperture area expressed as a multiple of the aperture required to operate the power cycle at its design capacity.

Solar PV

The technical potential for solar utility-scale PV was first determined by eliminating areas deemed unlikely for development. These include areas of environmental concern and national parks. Note that the exclusions do not include potentially culturally sensitive areas as there is not currently a comprehensive data set of those sites available. In addition to land-use constraints, the analysis extent was limited to tribal lands. Next, the available land within each tribal boundary was separated into urban and rural classifications. This allows for a greater understanding of the geographic quality of PV potential, i.e., proximity to areas where the electricity might be used.

Urban available lands were constrained to eliminate impervious surfaces. This has the effect of removing roads, parking lots, and buildings, leaving only urban open space. The urban open spaces were further constrained to eliminate contiguous areas less than 18,000 square meters: This ensures the total system size is large enough to be considered utility scale.[19]

Rural available lands were constrained to eliminate areas less than 1 square kilometer. The area constraint reduces highly fragmented parcels.

The final step in calculating technical potential required a specific PV system. The PV system chosen was a 1-axis tracking collector with the axis of rotation aligned north-south at 0° tilt from the horizontal. Assuming a power density of 48 MW per square kilometer (Lopez et al. 2012), the technical potential capacity was estimated and can be expressed as:

$$PVcap_t = \sum_{i \in t} A_i \cdot PD$$

Where

t = distinct Alaska Native corporation
$PVcap_t$ = PV capacity in Alaska Native corporation t (MW)
A_i = square kilometers of available land in grid-cell i
i = distinct grid-cell
PD = power density (48 MW/km^2)

To determine technical potential generation, capacity factors were estimated. State-level capacity factors were taken from Lopez et al. 2012. Technical potential generation can be expressed as:

$$PVgen_t = \sum_{i \in t} PVcap_t \cdot 8760hr \cdot CF_i$$

Where

t = distinct Alaska Native corporation
$PVgen_t$ = PV generation in Alaska Native corporation t (MWh)
$PVcap_t$ = PV capacity in Alaska Native corporation t (MW)
i = distinct grid-cell
CF = capacity factor for grid-cell i

[19] Depending on the PV system, 18,000 m^2 is roughly a 1-MW system.

Wind

Wind was analyzed at 80 m above the earths' surface. Only windy areas greater than or equal to an annual average gross[20] capacity factor of 30% were included in the analysis. The gross capacity factors used in the analysis were developed by AWS Truepower; they represent typical utility-scale wind turbine power curves.

The resource areas were filtered to remove areas deemed unlikely for development, including national parks, federally protected lands, and water features.

Technical potential capacity for wind was estimated assuming 5 MW/km² (Lopez et al. 2012) and can be expressed as:

$$Windcap_t = \sum_{i \in t} A_i \cdot PD$$

Where

t = distinct Alaska Native corporation
$Windcap_t$ = wind capacity in Alaska Native corporation *t* (MW)
A_i = square kilometers of available land in grid-cell *i*
i = distinct grid-cell
PD = power density (5 MW/km^2)

Technical potential generation for wind was estimated assuming 15% energy losses (Lopez et al. 2012) and can be expressed as:

$$Windgen_t = \sum_{i \in t} Windcap_t \cdot 8760hr \cdot CF_i \cdot loss$$

Where

t = distinct Alaska Native corporation
loss = 15% reduction from gross to net generation
$Windgen_t$ = wind generation on Alaska Native corporation *t* (MWh)
$Windcap_t$ = wind capacity on Alaska Native corporation *t* (MW)
CF_i = capacity factor for grid-cell *I*
i = distinct grid-cell

[20] Gross capacity factor does not include plant downtime, parasitic power, or other factors that would be included to reduce output to the "net" capacity factor. For more information on capacity factors, see http://www.eia.gov/tools/faqs/faq.cfm?id=187&t=3.

Appendix B: Government-Sponsored Loan Programs in Detail

Table 6. Government-Sponsored Loan Programs

Loan Programs	Type	Details
Rural Development Biorefinery Assistance Program (USDA)	Guarantee	Up to 90% of loan amount Technology: commercial-scale biorefinery Applications: equipment, construction, permitting, land acquisition, cost of financing
Power Project Loan Fund (AEA)	Loan	Amount varies Technology: solar, wind, MSW Applications: for development or upgrade of small-scale power production (<10 MW), conservation facilities, and bulk fuel storage, includes transmission and distribution
Indian Affairs Loan Guaranty, Insurance, and Interest Subsidy Program (Bureau of Indian Affairs [BIA])	Guarantee	Max 90%; interest subsidy covers the difference between the lender's rate and the Indian Financing Act rate Requirements: Borrower must have 20% tangible equity in the project. This is for business development.
Section 1703 Loan Guarantee Program (DOE)	Guarantee	Amount varies Requirements: must be precommercial technology Technology: biomass, hydrogen, solar, wind, hydro, transmission and distribution technologies No open solicitations
Rural Energy for America Program (REAP) Loan Guarantee Program (USDA)	Guarantee	Up to 85% of loan amount Requirements: Borrower must be rural small business or agricultural producer Technology: biomass, solar, wind, hydro, hydrogen, geothermal Applications: equipment, construction, permitting, professional service fees, feasibility studies, business plans, land acquisition No open solicitations

Table 7. Other Government-Sponsored Programs

Other	Type	Details
Advanced Biofuel Payment Program (USDA)	Other	Amount varies based upon production Technology: advanced biofuel refineries (excl. biofuels from corn kernel starch)
Qualified Energy Conservation Bonds (DOE)	Other	Amount varies Technology: solar, wind, biomass, hydro, geothermal, MSW, anaerobic digestion, tidal, wave, ocean thermal energy conversion, landfill gas-to-energy (LFGTE)

Table 8. Government-Sponsored Grants

Grant		Eligibility
Rural Energy for America Program (REAP) Grant Program (USDA)	Grant	\$2,500–\$500,000 or 25% of project costs, whichever is less Requirements: borrower must be rural small business or agricultural producer Technology: biomass, solar, wind, hydro, hydrogen, geothermal Applications: equipment, construction, permitting, professional service fees, feasibility studies, business plans, land acquisition
Alaska Renewable Energy Fund (AEA)	Grant	Varies, funded by state appropriations on an annual basis, no cap on per-project grant amount Requirements: cost share not required but considered favorable Technology: solar, wind, biomass, hydro, geothermal, LFGTE, tidal, wave, anaerobic digestion Application: feasibility studies, reconnaissance studies, energy resource monitoring, design and construction, transmission and distribution linking an eligible project to the grid, natural gas projects in small communities may also be eligible Additional info: State legislature must approve each project. Applications for FY14 grants were due in September 2012. Expires 6/30/2023. No open solicitations
High Energy Cost Grant Program (USDA)	Grant	\$75,000–\$5,000,000 Requirements: community's average home energy costs must exceed 275% of national average Technology: solar, wind, biomass, hydro Applications: energy generation and transmission and distribution No open solicitations
Tribal Energy Program Grant (DOE)	Grant	Amount varies Requirements: varies by solicitation Technology: solar, wind, biomass, hydro, geothermal No open solicitations
Energy and Mineral Development Program (BIA)	Grant	Amount varies Applications: evaluation of energy and mineral resources on tribal lands Annual solicitations

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